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MODULAR STORAGE TANK

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(57) Claim

1. A tank module comprising :

a frame having a pair of opposing vertical, generally elongate flanges connected by a pair of opposing horizontal, generally elongate members;

each of the vertical flanges having a corrugated mounting plate associated therewith, said mounting plate extending towards the opposing vertical flange;

each of the horizontal members having a first longitudinal flange extending toward the opposing horizontal member and a second longitudinal flange extending substantially perpendicular to the first longitudinal flange; and

one or more corrugated sheets mounted between the vertical flanges and horizontal members of the frame in a watertight manner.

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8. A storage tank comprising :

a plurality of tank modules arranged at least side by side to form a perimeter of the tank and having adjacent vertical flanges of adjacent modules connected together;

a plastics sheet of a size to fit within the perimeter of the tank sealed to the second longitudinal flange of a lowermost horizontal member of each of the plurality of modules; and

a tank top mounted to the second longitudinal flange of an uppermost horizontal member of each of the plurality of modules;

said modules comprising a frame having a pair of opposing vertical, generally elongate flanges connected by a pair of opposing horizontal, generally elongate members; each of the vertical flanges having a corrugated mounting plate associated therewith, said mounting plate extending towards the opposing vertical flange; each of the horizontal members having a first longitudinal flange extending toward the opposing horizontal member and a second longitudinal flange extending substantially perpendicular to the first longitudinal flange; and one or more corrugated sheets mounted between the vertical flanges and horizontal members of the frame in a watertight manner.

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14. A method of constructing a tank module including the steps of :

forming a first side assembly by

I) holding a vertical flange in a jig;

ii) positioning a bottom short mounting angle in said jig abutting a bottom portion of said vertical flange and fixing said angle to said flange;

iii) positioning a top short mounting angle in said jig abutting a top portion of said vertical flange and fixing said angle to said flange;

iv) positioning a mounting plate in said jig abutting said vertical flange but spaced from said top and bottom short mounting angles by a distance equal to the thickness of a horizontal member and fixing said mounting plate to said flange;

repeating steps I) through iv) to form a complimentary side assembly;

abutting top and bottom horizontal members between said complimentary side assemblies and fixing the horizontal members to the vertical flanges of the complimentary side assemblies;

fixing a plurality of sheets to said horizontal members and said mounting plates.

18. A method of constructing a storage tank including the steps of:

arranging a plurality of modules to form at least one row defining a perimeter of the tank, said modules comprising a frame having a pair of opposing vertical, generally elongate flanges connected by a pair of opposing horizontal, generally elongate members; each of the vertical flanges having a corrugated mounting plate associated therewith, said mounting plate extending towards the opposing vertical flange; each of the horizontal members having a first longitudinal flange extending toward the opposing horizontal member and a second longitudinal flange extending substantially perpendicular to the first longitudinal flange; and one or more corrugated sheets mounted between the vertical flanges and horizontal members of the frame in a watertight manner;

connecting the adjacent vertical flanges of adjacent modules;

sealing a sheet of plastics material to the second longitudinal flange of the lowermost horizontal members of the plurality of modules; and

mounting a tank top to the second flange of the uppermost horizontal members of the plurality of modules.

ABSTRACT

TITLE: MODULAR STORAGE TANK

A storage tank module consists of a frame (7) and a number of horizontally extending sheets (8) of corrugated steel. The frame comprises a pair of substantially vertical flanges (9) joined by a pair of substantially horizontal members (13). A corrugated mounting plate (11) is welded perpendicular to each vertical flange (9). The horizontal member (13) is curved in the longitudinal direction so as to have a radius of curvature appropriate to the size tank to be constructed and comprises a first longitudinal member (15) extending in the same direction as the vertical flange (9) and a second longitudinal member (16) extending perpendicular from the first longitudinal member (15). The sheets (8) are fixed to the mounting plate (11) and longitudinal flange (16) which lie on the outside of the module.

The completed modules (6) are connected together to form a storage tank (5). An appropriate number of modules (6) are assembled in one or more rows to construct tanks of a variety of capacities.

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Section 29

AUSTRALIA

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PATENT REQUEST: STANDARD PATENT

I, being the person identified below as the Applicant, request the grant of a patent to the person identified below as the Nominated Person, for an invention described in the accompanying standard complete specification.

Full application details follow.

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TO: THE COMMISSIONER OF PATENTS
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P/00/008
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Regulation 3.1(2)

AUSTRALIA

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NOTICE OF ENTITLEMENT

I, COLIN STEVEN BRIEN, of Princes Highway, Wandandian, New South Wales 2540, Australia, being the applicant in respect of the enclosed application state the following:

PART I

The person nominated for the grant of the patent is the actual inventor.

PART II

The person nominated for the grant of the patent is the applicant of the provisional application listed on the patent request form.

DATED: This Seventh day of November 1997

COLIN STEVEN BRIEN
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P/00/011
Regulation 3.2

AUSTRALIA

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ORIGINAL
COMPLETE SPECIFICATION
STANDARD PATENT

Invention Title: "MODULAR STORAGE TANK"

The following statement is a full description of this invention, including the best method of performing it known to me:

MODULAR STORAGE TANK

THIS INVENTION relates to storage tanks, and particularly to water tanks for use in rural properties for storing large quantities of water. The storage tanks may also be used for other substances such as grain or molasses.

BACKGROUND OF THE INVENTION

The most common form of water tank is the corrugated iron water tank which has provided reasonably clean water to Australian consumers for over one hundred years. A typical prior art corrugated iron water tank is shown in FIG 1 and described in detail later.

Much of the relevant prior art is discussed in earlier International Patent Application Number PCT/AU92/00526 in the name of Colin Steven Brien, which discussion is incorporated herein by reference.

A number of attempts have been made to overcome one or more of the problems mentioned in the referenced discussion. One such attempt is described in United States Patent number 4305518 in the name of Boyd. Boyd describes a portable fibreglass reinforced plastic storage tank which includes a plurality of moulded pre-formed

base sections which may be assembled to form a base of a desired diameter and a plurality of vertical side panels having an interior composite layer which includes an exposed chemical resistant interior surface and reinforced vertical and circumferential joints. Fibreglass tanks are not capable of storing large volumes of water due to the stress applied by the weight of the water. Furthermore, the effect of ultraviolet light is to degrade and weaken the plastic leading to catastrophic failure.

Another prior art approach is described in Australian Patent Application number 56750/86 in the name of Interlock Limited. The Interlock tank is formed from a plurality of curved panel members formed from a flat plate held in a frame of four flanges. The flanges are secured together to form the tank. Because the panel members have minimal stress bearing capacity they must be kept small therefore leading to a requirement for a large number of panel members, and long assembly time, to produce a tank. Furthermore, a plurality of metal bands are needed to overcome hoop stress in the finished tank. The use of the Interlock tank is limited to relatively small volumes.

A further prior approach is found in Australian Patent Application Number 68600/87 in the name of John Sydney Haines. Haines describes a demountable storage tank which is formed by bolting together a serious of top, bottom and side panels. As with the

Interlock tank, the panels of the Haines tank have limited inherent load bearing capacity and therefore the size of tank that can be constructed is extremely limited.

Reference may also be had to a number of patents which serve to define the general state of the art in water tank construction including : Australian Patent Application number 38935/85; Australian Patent Application number 45341/85; Australian Patent Application Number 62098/86; Australian Patent Application number 52474/90; Australian Patent Application number 62518/90 and Australian Patent number 404278.

The aforementioned International Patent Application number PCT/AU92/00526 describes a water tank module consisting of a frame and a number of horizontally extending sheets of corrugated steel covered on one side with food grade polymer. The frame comprises a pair of substantially vertical longitudinal angle irons having two perpendicular flanges joined by a pair of substantially horizontal angle irons curved in their longitudinal direction so as to have a radius of curvature appropriate to the size tank to be constructed from the modules. The horizontal angle irons have two flanges, a first one of which extends transversely to the frame so as to extend in the same direction as the radial flanges of the vertical angle irons. The other flanges of the angle irons are arranged to extend inwardly in the plane of the frame on the outer side as compared to

the curvature of the frame so as to lie on the outside of the tank when it is constructed. The complete frames are galvanised and then the sheets of corrugated iron are mounted thereto. A number of such modules are bolted together through apertures in the flanges to form a tank and a plastic sheet is then sealed to the bottom flange to form the bottom of the tank. The modules are thus easily transportable and the tank can be constructed on site.

Tanks of the above construction have proven very successful and have stored volumes of water up to 10000 litres. However, the inventor has found through personal experience that the tanks suffer catastrophic failure under dynamic load for volumes above about 10000 litres. In one instance, a tank having the construction described in PCT/AU92/00526 held a volume of 10000 litres under static conditions but when a relatively minor dynamic load was applied by pushing the side of the tank the fixing of the sheets to the radial flanges of the vertical angle irons failed leading to collapse of the tank.

OBJECT OF THE INVENTION

It is an object of the present invention to provide modules for forming a tank which is quick and simple to construct yet capable of storing large volumes of water.

It is a further object of the invention to provide a storage

tank formed from the modules.

Other objects will be evident from the following description.

SUMMARY OF THE INVENTION

In one form, although it need not be the only or indeed the broadest form, the invention resides in a tank module comprising :

a frame having a pair of opposing vertical, generally elongate flanges connected by a pair of opposing horizontal, generally elongate members;

each of the vertical flanges having a corrugated mounting plate associated therewith, said mounting plate extending towards the opposing vertical flange;

each of the horizontal members having a first longitudinal flange extending toward the opposing horizontal member and a second longitudinal flange extending substantially perpendicular to the first longitudinal flange; and

one or more corrugated sheets mounted between the vertical flanges and horizontal members of the frame in a watertight manner.

In preference the corrugations of the mounting plate are of substantially the same pitch and depth as the corrugations of the

sheets.

The tank module suitably further comprises a short mounting angle fixed to the horizontal member at each end. The mounting angle aids alignment during assembly of the tank module.

The tank modules can be assembled to form a storage tank suitable for a variety of substances. For water storage the corrugated sheets are mounted in a watertight manner to the first longitudinal flanges of the horizontal members and the corrugated mounting plates. To achieve waterproofing a sealing compound is used between the sheets and the mounting plate and between the sheets and the first longitudinal flange. A suitable sealing compound is silicone.

In a further form the invention resides in a storage tank comprising :

a plurality of tank modules as described above arranged at least side by side to form a perimeter of the tank and having adjacent vertical flanges of adjacent modules connected together;

a plastics sheet of a size to fit within the perimeter of the tank sealed to the second longitudinal flange of a lowermost horizontal member of each of the plurality of modules; and

a tank top mounted to the second longitudinal flange of an uppermost horizontal member of each of the plurality of modules.

The storage tank may comprise more than one row of

modules arranged on top of each other with adjacent second longitudinal flanges of vertically adjacent modules joined together.

In preference the storage tank further comprises a first plastics extrusion snap fitted to the second longitudinal flange of the lowermost horizontal members of the plurality of modules. For this purpose the second longitudinal flange has a channel receiving a clip portion of the first plastics extrusion. The plastics sheet is sealed to the second longitudinal flange of the lowermost horizontal members of the plurality of modules by clamping the plastic sheet between a second extrusion and the first extrusion, the second extrusion being snap fitted to the first extrusion after a perimeter portion of the plastics sheet is laid over the first extrusion so that the plastics sheet is clamped between the first extrusion and the second extrusion.

The tank top of the storage tank may be substantially flat or conical.

In a still further form the invention resides in a method of constructing a tank module including the steps of :

forming a first side assembly by

i) holding a vertical flange in a jig;

ii) positioning a bottom short mounting angle in said jig abutting a bottom portion of said vertical flange and fixing said angle to said flange;

iii) positioning a top short mounting angle in said jig

abutting a top portion of said vertical flange and fixing said angle to said flange;

iv) positioning a mounting plate in said jig abutting said vertical flange but spaced from said top and bottom short mounting angles by a distance equal to the thickness of a horizontal member and fixing said mounting plate to said flange;

repeating steps I) through iv) to form a complimentary side assembly;

abutting top and bottom horizontal members between said complimentary side assemblies and fixing the horizontal members to the vertical flanges of the complimentary side assemblies;

fixing a plurality of sheets to said horizontal members and said mounting plates.

If the tank module is to be used in constructing a water tank the method will further include the step of waterproof sealing the tank module.

If required, the tank module can be reinforced by including the step of fixing a hoop band between the vertical flanges to provide support to the sheets.

In a yet further form the invention resides in a method of constructing a storage tank including the steps of :

arranging a plurality of modules of the above type to form at least one row defining a perimeter of the tank;

connecting the adjacent vertical flanges of adjacent modules;

sealing a sheet of plastics material to the second longitudinal flange of the lowermost horizontal members of the plurality of modules; and

mounting a tank top to the second flange of the uppermost horizontal members of the plurality of modules.

The step of sealing may further include the steps of clipping a first extrusion to the second longitudinal flange of the lowermost horizontal members, positioning a peripheral portion of a plastics sheet over the first extrusion and snap fitting a second extrusion into a cooperating portion of the first extrusion to clamp the plastics sheet between the first and second extrusion.

One or more further rows of modules may be connected on top of the first row to construct larger tanks.

BRIEF DETAILS OF THE DRAWINGS

To assist in understanding the invention preferred embodiments will now be described with reference to the following figures in which :

Figure 1 is a sketch of a known water tank formed of a number of sheets of corrugated steel;

Figure 2 is a sketch of a water tank according to one embodiment of the present invention;

Figure 3 is an external cut-away perspective view of one module used in the construction of the water tank shown in Figure 2;

Figure 4 is an internal cut-away perspective view of the module of Figure 3;

Figure 5 is a schematic cross-sectional view on line V-V of Figure 2;

Figure 5A is a schematic cross-sectional view similar to Figure 5, but of an alternate embodiment;

Figure 5B is a schematic cross-sectional view similar to Figure 5, but of an further embodiment;

Figure 6 is a schematic cross-sectional view on line VI-VI of Figure 2;

Figure 7 is a schematic cross-sectional view on line VII-VII of Figure 2;

Figure 8 is a schematic cross-sectional view similar to Figure 5A and showing the bottom of the tank;

Figure 9 is a schematic cross-sectional view through a tensioning means used to support the top of the tank of Figure 2;

Figure 10 is a part cutaway plan view of the tank of Figure 2;

Figure 11 is a schematic cross-sectional view on line XI-

XI of Figure 10;

Figure 12 is a schematic cross-sectional view similar to a portion of Figure 9, but showing an alternate embodiment; and

Figure 13 is an exploded sketch drawing of a tank according to a further embodiment of the present invention

DETAILED DESCRIPTION OF THE DRAWINGS

In the drawings, like reference numerals refer to like parts.

As described above, Figure 1 shows a conventional known water tank 1 formed of a number of overlapping sheets 2 of horizontally corrugated steel. The sheets are fixed together by rivets 4 and the complete tank, including the top 3 and the bottom is constructed by the manufacturer and then transported whole to the customer. Clearly, there is an upper limit on the size of tank which can be economically transported either by rail or road. There is also a limit on the volume of water that can be safely stored in such a tank before the seems fail and catastrophic failure occurs.

One embodiment of the present invention is shown in Figure 2, where a water tank 5 is shown constructed of a number of modules 6. Each module 6, as best shown in Figure 3 and Figure 4, consists of a frame 7 and a number, in this case three, of horizontally

extending sheets 8 of corrugated steel. The sheets 8 are covered on the inside by food grade polymer and are preferably the sheets manufactured by BHP Steel under the name Aquaplate.

The frame 7 comprises a pair of opposing substantially vertical longitudinal flanges 9. A corrugated mounting plate 11 extends perpendicularly from each vertical flange 9 towards the opposing vertical flange. The corrugated mounting plate 11 is fixed to the vertical flange 9 in suitable manner, such as by weld 10 (seen in Figure 5). The corrugations of the mounting plate 11 are matched to the corrugations of the sheets 8 so that the mounting plate 11 supports the sheets 8. Each vertical flange 9 is provided with a number of apertures 12 spaced at intervals along its length.

The two vertical flanges 9 are joined together to form the frame 7 by two substantially horizontal members 13, which may conveniently be angle irons. The vertical flanges 9 and horizontal members 13 are joined together by cutting appropriate indents and welding together 14. The horizontal members 13 are curved in their longitudinal direction so as to have a radius of curvature appropriate to the size tank which is to be constructed from the modules. A first longitudinal flange 15 of horizontal member 13 extends transversely to the frame so as to extend in the same direction as vertical flanges 9 and is optionally provided with a number of spaced aperture holes similar to holes 12 in vertical flanges 9.

A second longitudinal flange 16 of the members 13 are arranged to extend inwardly in the plane of the frame 7 on the outer side as compared to the curvature of the frame 7. Thus, the outer flanges 16 and the corrugated mounting plates 11 lie on the outside of the tank when it is constructed. The completed frames 7 are galvanised before the sheets 8 are mounted thereto.

As can be seen in Figure 3 and Figure 4, the corrugated sheets 8 are curved with the corrugations running horizontally to the same curvature as the frame 7. The sheets are fixed together along their overlapped portions 18 by means of fasteners 19, and are also fixed to the mounting plate 11 and flange 16 of members 13 by means of similar fasteners 20 and sealed thereto using silicone 21 (as seen most clearly in Figure 8). Silicone is also used to seal the overlap 18 between two sheets, although the sheets may alternatively be joined using a standard "lockseam". All fasteners are also covered with silicone inside the tank. Suitable fasteners include rivets, screws and welds.

A reinforcing band 17 is shown in Figure 3 for reinforcing the tank module against hoop stress. The band 17 may be optionally bolted between vertical flanges 9 in the region of overlapping portions 18. Although a single band is shown it will be appreciated that multiple bands can be employed as required.

To assist with assembly of the modules a short mounting

angle 14 is welded to the flange 9 so as to form a guide for positioning of the horizontal member 13 between the mounting plate 11 and the mounting angle 14. To construct a module, a vertical flange 9, top and bottom mounting angles 14 and mounting plate 11 are positioned in a jig. The mounting angles 14 and the mounting plate 11 are welded to the vertical flange. The process is repeated to form complimentary right and left hand ends. Top and bottom horizontal members 13 are then positioned between the mounting angles 14 and the mounting plate 11 and welded to form a four-sided frame. The sheets 8 are overlapped, joined with fasteners 18 and positioned in the frame. The sheets are then fixed to the frame with fasteners 20 to complete the module. The construction of the module in the region of a corner is shown in Figure 5.

As seen most clearly in Figure 7, but also in Figure 3, multiple fasteners are used to fix the sheets 8 to the mounting plate 11. The use of a corrugated mounting plate and multiple fasteners spreads the stress on the fasteners and improves the load bearing capacity therefore allowing construction of larger volume tanks than can be achieved by prior art arrangements.

It will be appreciated that the curvature of the horizontal members 13 will depend on the radius of the tank to be constructed and on the number of modules to be used. For example, a convenient size for the modules is 3.0m around the curved face and 2.3m high. The module dimensions do not necessarily change with tank size, only the radius and

number of modules per tank so as to allow high volume production methods to be employed. For example, a tank of approximately 100000 litre capacity can be constructed using eight modules having a radius of 3.8m. According to the size of tank, different sizes of angle irons can be used. The 100000 litre tank employs horizontal members of 40mm x 40mm x 5mm, vertical flanges of 6mm x 50mm and corrugated mounting plates of 100mm x 1.6mm.

In order to construct the tank 5, the first horizontal row of modules 6 is arranged in a circle in the desired location for the tank so that the modules are standing vertically with the vertical flanges 9 of adjacent modules 6 adjacent each other. As best shown in Figure 7, bolts 22 are then passed through apertures 12 of flanges 9 and clamped together by tightening a nut 23 on bolt 22. A closed cell neoprene gasket can be placed between flanges 9 so as to form a water tight seal when the bolts and nuts are tightened.

Although Figure 2 shows a tank 5 with two rows of modules 6, one on top of the other, it will be appreciated that in many cases only one such row of modules will be desired. The 100000 litre tank described above has a single layer of eight modules. If, however, two or more rows of modules are necessary, the two rows are bolted together, as shown in Figure 6, using similar bolts 22 and nuts 23 passing through apertures 12 in flanges 15 of the horizontal members 13. A spacer 24 is bolted between the flanges 15 to account for the space caused by mounting

angles 14.

In order to construct the floor of the tank a first plastic extrusion 25 is mounted to flange 15 of the lowermost horizontal member 13, as shown in Figure 5. The extrusion 25 comprises a lower portion 27 which fits below lower flange 15 and a clip portion 28 which extends downwardly towards the end of lower portion 27 so as to form a slot 29 in the extrusion 25. In mounting, the extrusion 25 is forced towards flange 16 until clip portion 28 clips into a channel 30 formed in the flange 15 to create a watertight seal.

In an alternate form shown in Figure 5A, a length of flat bar 26 is spot welded to flange 15 to provide a step upstanding from the flange 15. In mounting, the extrusion 25 is forced towards flange 16 until clip portion 28 clips over step 26.

In both embodiments of the extrusion, the upper portion of extrusion 25 is formed in the shape of a channel 31 having walls 32, each having a downwardly facing step abutment 33.

In a further embodiment shown in Figure 5B, the extrusion can comprise only the channel portion 31 with the vertical walls 32 and downwardly facing step abutments 33. This extrusion can be fastened through the bottom of channel 31 to flange 15 using fasteners 34.

As best shown in Figure 8, with any of the extrusions shown in Figure 5, Figure 5A or Figure 5B, the channel 31 forms a female half of a clamp which clamps a sheet 35 of 0.5mm food grade polymer sheeting

in position. The sheet 35 is first cut to the approximate shape of the bottom of the tank and the outer periphery of the sheet 35 is then positioned over the channel 31 in extrusion 25. The male part of the clamp formed by extrusion 36 having ledges 37 on its lower portion which fit below step abutments 33 to clamp sheet 35 therebetween. Thus the bottom of the tank can be easily fitted on site.

The top of the tank 5 is shown in Figure 2 as being a substantially conical top 38, the configuration most preferred by consumers, especially those that live in areas that experience significant precipitation in the form of snow. The construction of this top is shown generally in Figures 9, 10 and 11. Although the top is conical in shape, the top supporting structure is all in tension rather like a suspension bridge as opposed to compression which is the normal style of manufacture.

In a compression top, all of the steel used has to have enough strength to span the tank radius in its own right and then support the top sheeting which is the actual cone seen from the outside of the tank.

This sheeting is screwed or bolted into place through the steel beams underneath. This method produces a good job but is costly in manufacture both in labour and materials and freight costs are significantly increased because of the weight and bulk involved. A lot of extra lifting is also involved for any person involved in the transportation or installation of the tank.

In the present invention, there is provided a short centre pole 39 the length of which is ten degrees above and ten degrees below the top of the walls of the tank 5. A 10mm flat plate 40A of suitable diameter (depending on the size of the tank) is fitted to the top end of the pole 39 and a similar plate 40B is fitted to the bottom end of the pole, whose ends are threaded to accept back nuts 41 each side of each plate 40A and 40B. The starting position for each plate 40A and 40B is 200mm from the end of the pole 39.

Radial rods 42 or 12mm galvanised steel are fastened between the bottom plate 40B and the flange 16 of the topmost horizontal member 13 at the top of the tank 5. The ends of the rods 42 are, in one embodiment, flattened and provided with an aperture therethrough so that they can be bolted using nuts and bolts 44 to the bottom plate 40B. The other end of each rod 42 is provided with a threaded portion 45. The flange 16 is provided with apertures 43 at appropriate positions to receive the rods 42 therethrough.

Where the radial rods 42 pass through the apertures 43 in the flange 16 at the top of the tank 5, lengths of 1.2mm x 32mm galvanised steel strapping 47 with 12mm holes in the end of them are placed over the end of each radial rod 42 and then a nut 46 is screwed onto the threaded portion 45 of the end of the rods 42. This effectively anchors each strap 47 to the member 13.

The other end of the straps 47 are now taken to the top

plate 40A at the centre of the tank 5 and secured to the plate 40A with bolts 48, although screws, such as 2 x M1100 screws could alternatively be used.

In order that this lightweight steel has enough strength to support the top sheeting it has to be tensioned. To do this, firstly the back nuts 41 on the centre pole 39 are would out towards the end of the pole at both ends, this operation will do almost all of the tensioning. If any individual rods 42 remain loose they can be tensioned by using the nut 46 on the end of each rod 42. In the case of the top straps 47, they can be further tensioned by screwing an M12 x 100mm screw 49 that passes through the flange 16 of the topmost member 13 from the inside of the tank 5 directly above the radial rod 42 so as to engage the strap 47. This tensions the strap 47 by pushing against it as it passes over the screw 49. At the conclusion of this operation, a light steel superstructure is now in place which tensions the structure of the tank and provides a secure support for the conical top.

As best shown in Figure 10, the galvanised straps 47 running to the top plate 40A, form the two long sides of a triangle. Galvanised steel sheeting 50 is cut to the shape and size of this triangle with 16mm extra on each long side. This 16mm is then bent right over and flattened down to the thickness of the galvanised strapping as shown in Figure 11.

These triangles 50 of galvanised steel can then be fitted to

the steel strapping 47 simply by holding half of them (one at a time) underneath the steel strapping with their top-most end up against the centreplate. This will allow the 16mm that has been bent over on the sheeting to clear the strap support 47.

By keeping the sheeting hard up against the strap 47 for its entire length, it can now be slid downwards towards the tank wall. The 16mm return on the sheet 50 will now pass over the top of the strap 47. When it reaches the centre of the strap 47, the sheet 50 will be at the bottom of its stroke and locked into position.

When every second panel 50 has been fitted from inside the tank 5, the remaining panels 50 can be fitted in like manner, but, reversed from outside. The last operation is to fit a top cap 51 to the tank 5, this covers the very top centre of the tank 5 above where the sheets extend to. The cap 51 is fitted with a self drilling screw that passes through the cap edge, a top panel, the support strap then the underside top panel. This screw is not only to fit the top cap but also to stop the top panels moving upwards and becoming unhooked off the support strap.

Thus the entire top of the tank can be fitted with no fasteners at all except for the locking screw. This amounts to more saving in time and materials.

As an alternative to this conical top 38, there can be fitted a flat top to the tank 5, as shown in the exploded view of Figure 13. This can take the form of a flat corrugated iron top. Such a top can be made no

more than 2.4m long so that they will fit across a standard truck body or container and therefore reduce freight costs. A problem arises in producing the curve shape to fit the round water tank, since no tooling exists which will cut smoothly across a corrugated profile. This problem is solved by marking out patterns for each section to the shape it would be with no corrugations in it. Each section is then traced onto flat galvanised iron, which can be cut with standard tooling to produce a smooth and burr free cut. The sections are then put through a rollforming machine which corrugates them and in so doing returns the curved portions to a perfect radius.

The top is supported in position by one or two light and simple trusses (depending on tank diameter) of conventional design. As shown in Figure 12, the open end of the corrugated top 52 is sealed using a bitumen impregnated foam rubber strip 53 which is 38mm x 25mm in cross section. The strip 53 is placed between the corrugated iron top 52 and the top flange 15 of horizontal member 13 of the tank 5. When screwed down using conventional roofing screws 54 the strip 53 compresses forming a seal that will exclude even fine dust.

Thus, the present invention overcomes a number of problems. The first one, that of avoiding materials that would pollute the water, was overcome by using the B.H.P product >AQUAPLATE=. Another of the significant problems was to produce a tank that lent itself to speed in production but retained ease of assembly by unskilled labour

and still remained environmentally unobtrusive to the eye in a rural scene. This problem is overcome by the construction of modular panels that can be easily joined to construct a tanks of various volumes.

The strength necessary for construction of high volume storage tanks is achieved by the use of a corrugated mounting plate having a profile matching the corrugated sheets of the tank. Multiple fasteners, as shown in Figure 7, are used to attach the sheeting to the mounting plates and horizontal members. Particular advantage is found by using two or more fasteners at each asymptote, that is, at both ridges and valleys of the corrugated iron.

A further advantage of the mounting plate construction is the ability to use the storage tanks described above for the storage of grain. Corrugated iron tanks are not usually suitable for storage of grain because when grain is drawn from the bottom of the tank the weight of the remaining grain bears on the corrugations and causes axial crush leading to a concertina compression of the tank. Asymptotic fastening of the sheets to the mounting plates provides the necessary support to prevent concertina compression, thereby making the tank suitable for storage of grain. Corrugated iron tanks offer a considerable economic benefit compared to existing tanks.

An objection raised by many people in the past concerning the installation of a water tank, is the need for them to pour concrete, or to provide a brick and timber tank stand of suitable proportions to mount the

tank on to protect it from ground movement. The present invention is intended to overcome this disadvantage.

Throughout the specification the aim has been to describe the preferred embodiments of the invention without limiting the invention to any one embodiment or specific collection of features. Various other modifications and improvements will be apparent to a person skilled in the art. For example, although the specification describes circular (cylindrical) tanks, the invention is also applicable to generally circular tanks which includes elliptical, pentagonal or octagonal cross-sectional shapes. Such modifications can be made without departing from the scope of the present invention.

The claims defining the invention are as follows

1. A tank module comprising :

a frame having a pair of opposing vertical, generally elongate flanges connected by a pair of opposing horizontal, generally elongate members;

each of the vertical flanges having a corrugated mounting plate associated therewith, said mounting plate extending towards the opposing vertical flange;

each of the horizontal members having a first longitudinal flange extending toward the opposing horizontal member and a second longitudinal flange extending substantially perpendicular to the first longitudinal flange; and

one or more corrugated sheets mounted between the vertical flanges and horizontal members of the frame in a watertight manner.

2. A tank module as claimed in claim 1 wherein the mounting plates are welded to the vertical flanges.

3. A tank module as claimed in claim 1 wherein the corrugations of the mounting plate are of substantially the same pitch and depth as the corrugations of the sheets.

4. A tank module as claimed in claim 1 further comprising a short mounting angle fixed to said horizontal member at each end thereof, said mounting angle providing alignment during assembly of the tank

module.

5. A tank module as claimed in claim 1 wherein said pair of horizontal members are curved longitudinally.

6. A tank module as claimed in claim 1 wherein the corrugated sheets are mounted in a watertight manner to the first longitudinal flanges of the horizontal members and the corrugated mounting plates.

7. A tank module as claimed in claim 1 further comprising a sealing compound between said sheets and said mounting plate and between said sheets and said first longitudinal flange.

8. A storage tank comprising :

a plurality of tank modules arranged at least side by side to form a perimeter of the tank and having adjacent vertical flanges of adjacent modules connected together;

a plastics sheet of a size to fit within the perimeter of the tank sealed to the second longitudinal flange of a lowermost horizontal member of each of the plurality of modules; and

a tank top mounted to the second longitudinal flange of an uppermost horizontal member of each of the plurality of modules;

said modules comprising a frame having a pair of opposing vertical, generally elongate flanges connected by a pair of opposing horizontal, generally elongate members; each of the vertical flanges having a corrugated mounting plate associated therewith, said mounting plate extending towards the opposing vertical flange; each of the

horizontal members having a first longitudinal flange extending toward the opposing horizontal member and a second longitudinal flange extending substantially perpendicular to the first longitudinal flange; and one or more corrugated sheets mounted between the vertical flanges and horizontal members of the frame in a watertight manner.

9. A storage tank as claimed in claim 8 further comprising more than one row of modules arranged on top of each other with adjacent second longitudinal flanges of vertically adjacent modules joined together.

10. A storage tank as claimed in claim 8 further comprising a first plastics extrusion snap fitted to the second longitudinal flange of the lowermost horizontal members of the plurality of modules, the second longitudinal flange having a channel receiving a clip portion of the first plastics extrusion.

11. A storage tank as claimed in claim 10 wherein the plastics sheet is sealed to the second longitudinal flange of the lowermost horizontal members of the plurality of modules by clamping the plastic sheet between a second extrusion and the first extrusion, the second extrusion being snap fitted to the first extrusion after a perimeter portion of the plastics sheet is laid over the first extrusion so that the plastics sheet is clamped between the first extrusion and the second extrusion.

12. A storage tank as claimed in claim 8 wherein the tank top is substantially flat.

13. A storage tank as claimed in claim 8 wherein the tank top is

substantially conical.

14. A method of constructing a tank module including the steps of:

forming a first side assembly by

i) holding a vertical flange in a jig;

ii) positioning a bottom short mounting angle in said jig abutting a bottom portion of said vertical flange and fixing said angle to said flange;

iii) positioning a top short mounting angle in said jig abutting a top portion of said vertical flange and fixing said angle to said flange;

iv) positioning a mounting plate in said jig abutting said vertical flange but spaced from said top and bottom short mounting angles by a distance equal to the thickness of a horizontal member and fixing said mounting plate to said flange;

repeating steps i) through iv) to form a complimentary side assembly;

abutting top and bottom horizontal members between said complimentary side assemblies and fixing the horizontal members to the vertical flanges of the complimentary side assemblies;

fixing a plurality of sheets to said horizontal members and said mounting plates.

15. The method of constructing a tank module according to

claim 14 further including the step of waterproof sealing the tank module.

16. The method of constructing a tank module according to claim 14 further including the step of fixing a hoop band between the vertical flanges to provide support to the sheets.

17. The method of constructing a tank module according to claim 14 wherein the step of fixing is welding.

18. A method of constructing a storage tank including the steps of:

arranging a plurality of modules to form at least one row defining a perimeter of the tank, said modules comprising a frame having a pair of opposing vertical, generally elongate flanges connected by a pair of opposing horizontal, generally elongate members; each of the vertical flanges having a corrugated mounting plate associated therewith, said mounting plate extending towards the opposing vertical flange; each of the horizontal members having a first longitudinal flange extending toward the opposing horizontal member and a second longitudinal flange extending substantially perpendicular to the first longitudinal flange; and one or more corrugated sheets mounted between the vertical flanges and horizontal members of the frame in a watertight manner;

connecting the adjacent vertical flanges of adjacent modules;

sealing a sheet of plastics material to the second longitudinal flange of the lowermost horizontal members of the plurality of

modules; and

mounting a tank top to the second flange of the uppermost horizontal members of the plurality of modules.

19. The method of constructing a water tank according to claim 18 wherein the step of sealing further includes the steps of :

clipping a first extrusion to the second longitudinal flange of the lowermost horizontal members;

positioning a peripheral portion of a plastics sheet over the first extrusion; and

snap fitting a second extrusion into a cooperating portion of the first extrusion to clamp the plastics sheet between the first and second extrusion.

20. The method of constructing a water tank according to claim 18 further including the step of arranging one or more further rows of modules on top of said at least one row defining a perimeter; and connecting the modules forming one or more rows together and to the modules forming the at least one row.

DATED this Seventh day of November 1997.

COLIN STEVEN BRIAN

By his Patent Attorneys

FISHER ADAMS KELLY

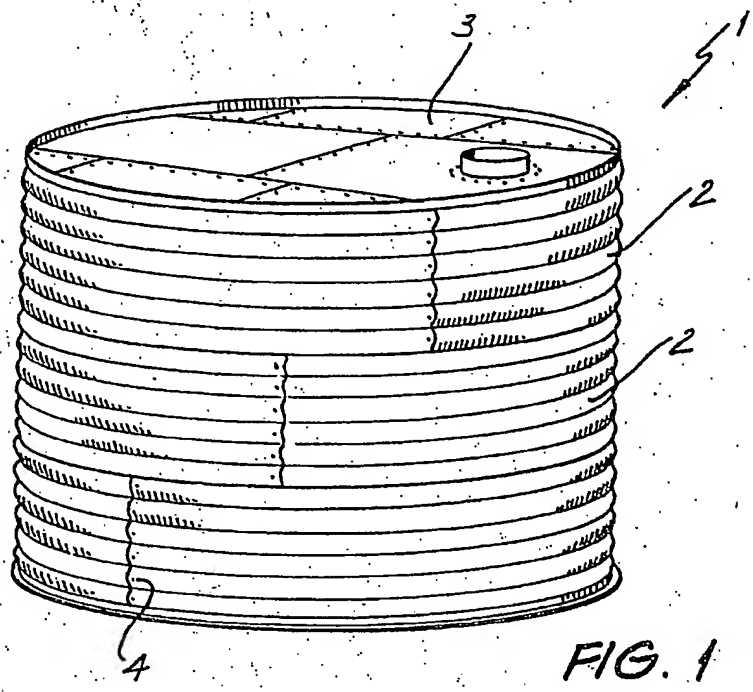


FIG. 1

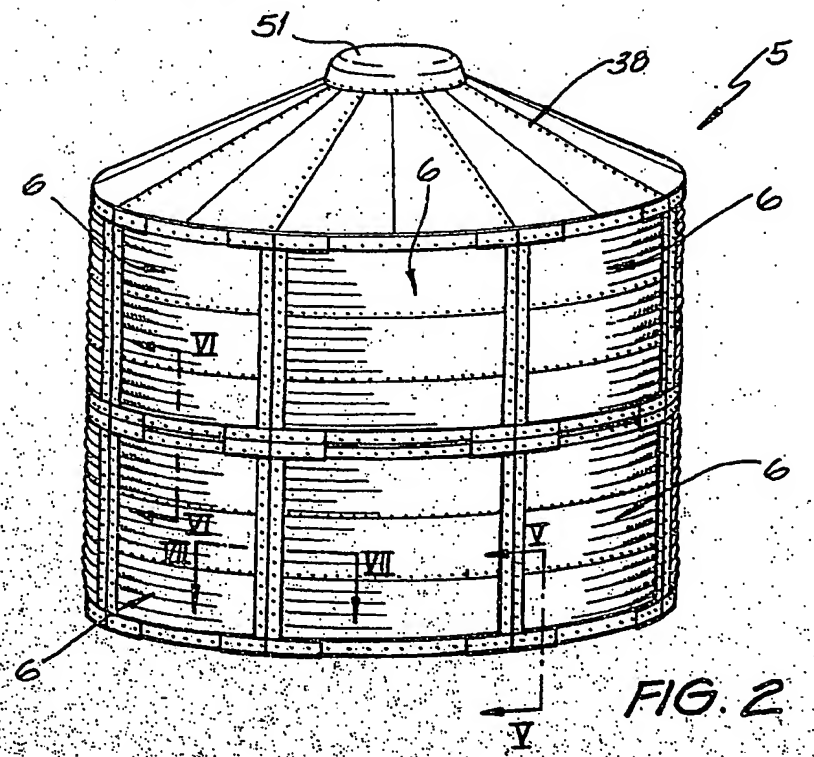
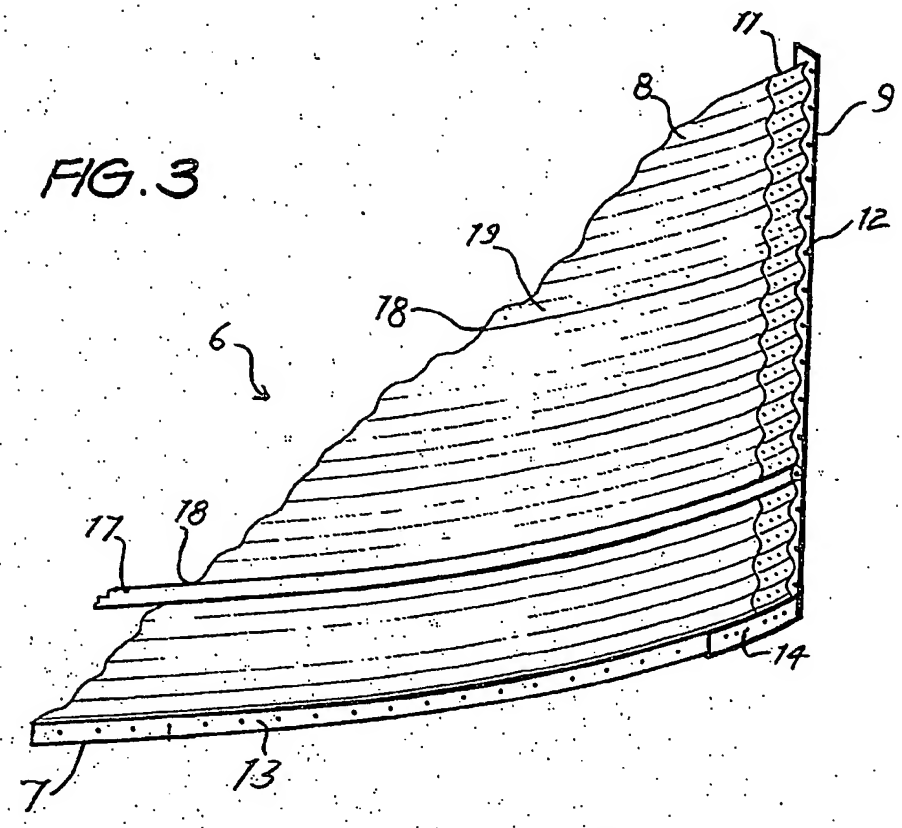


FIG. 2

FIG. 3



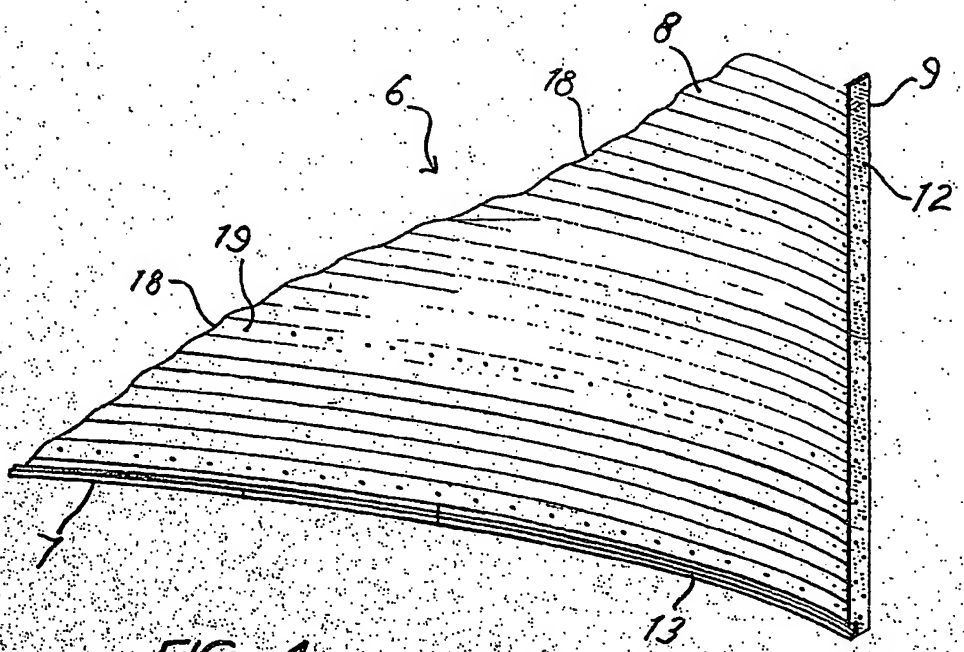


FIG. 4

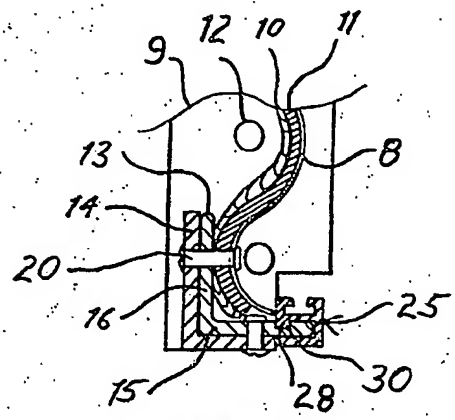


FIG. 5

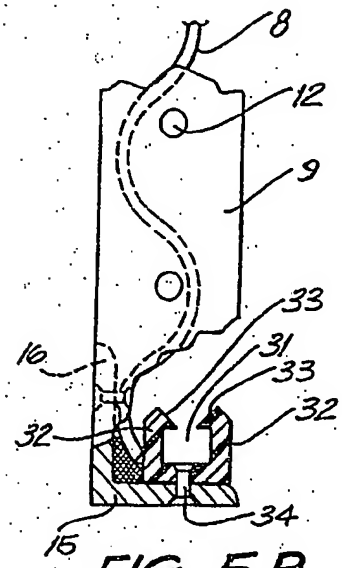


FIG. 5B

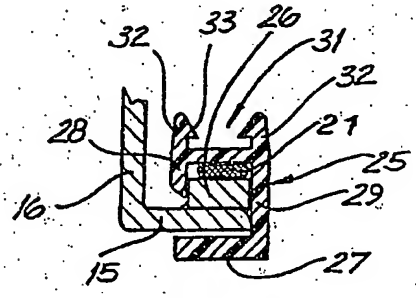


FIG. 5A

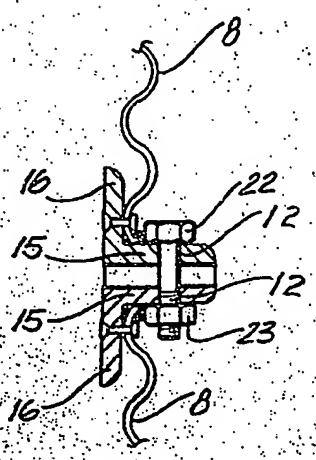


FIG. 6

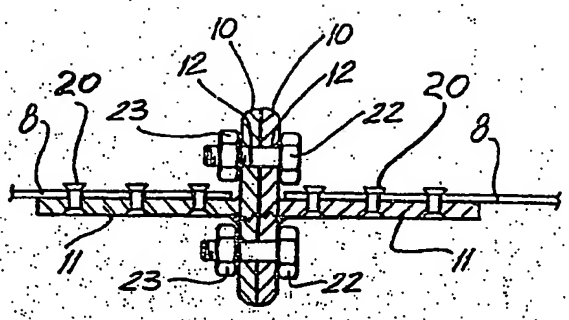


FIG. 7

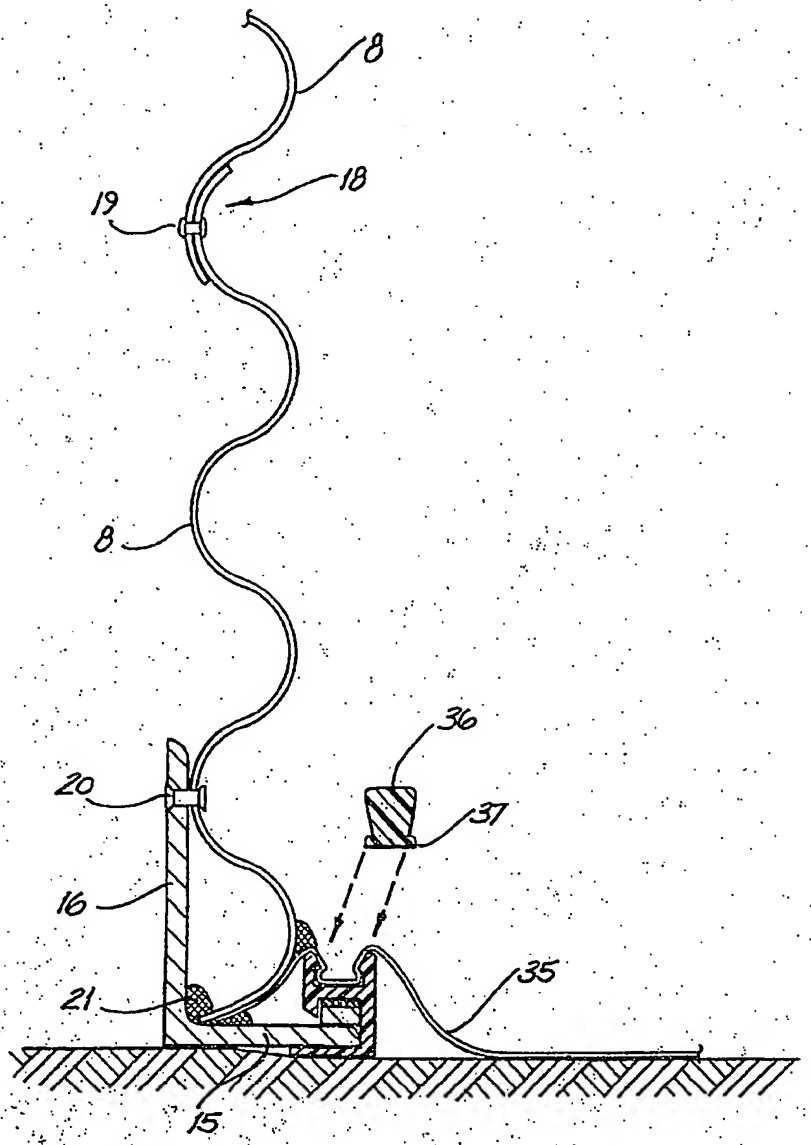


FIG. 8

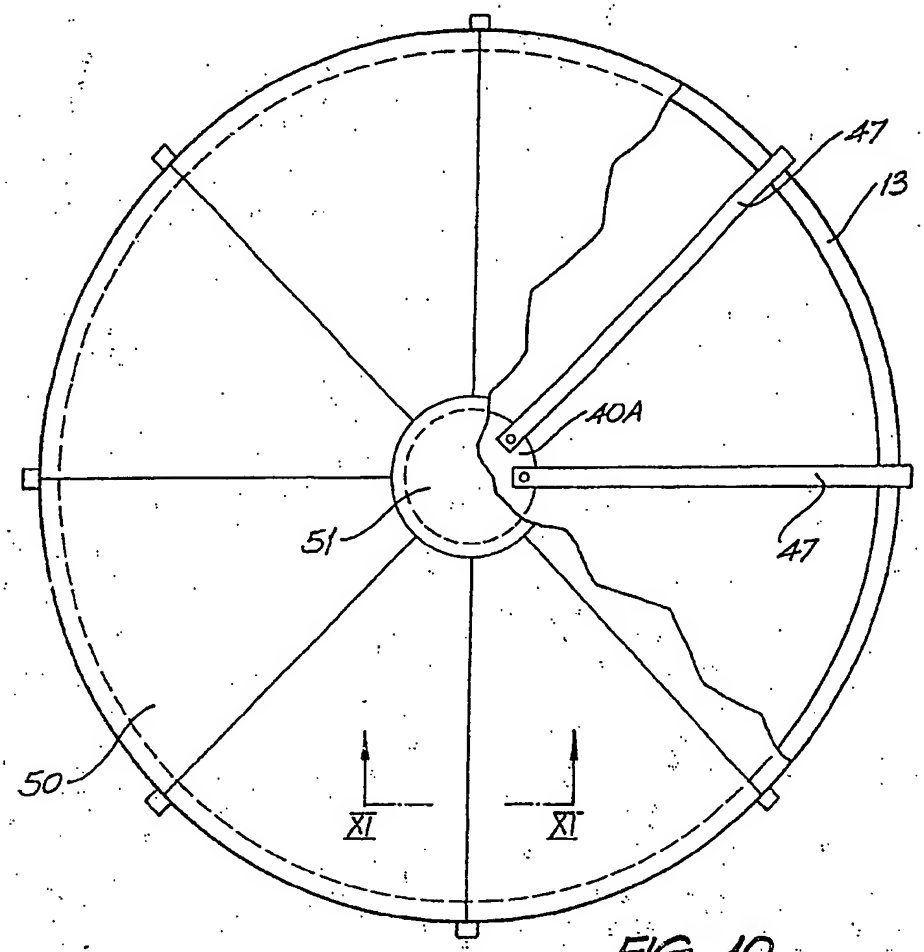


FIG. 10

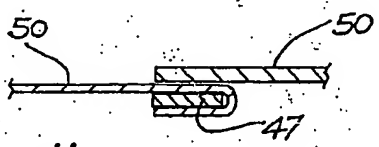


FIG. 11

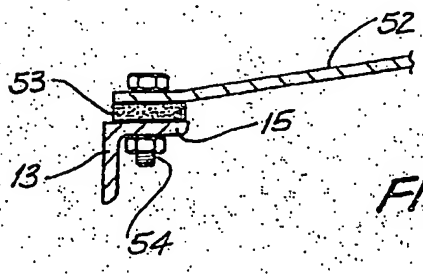


FIG. 12

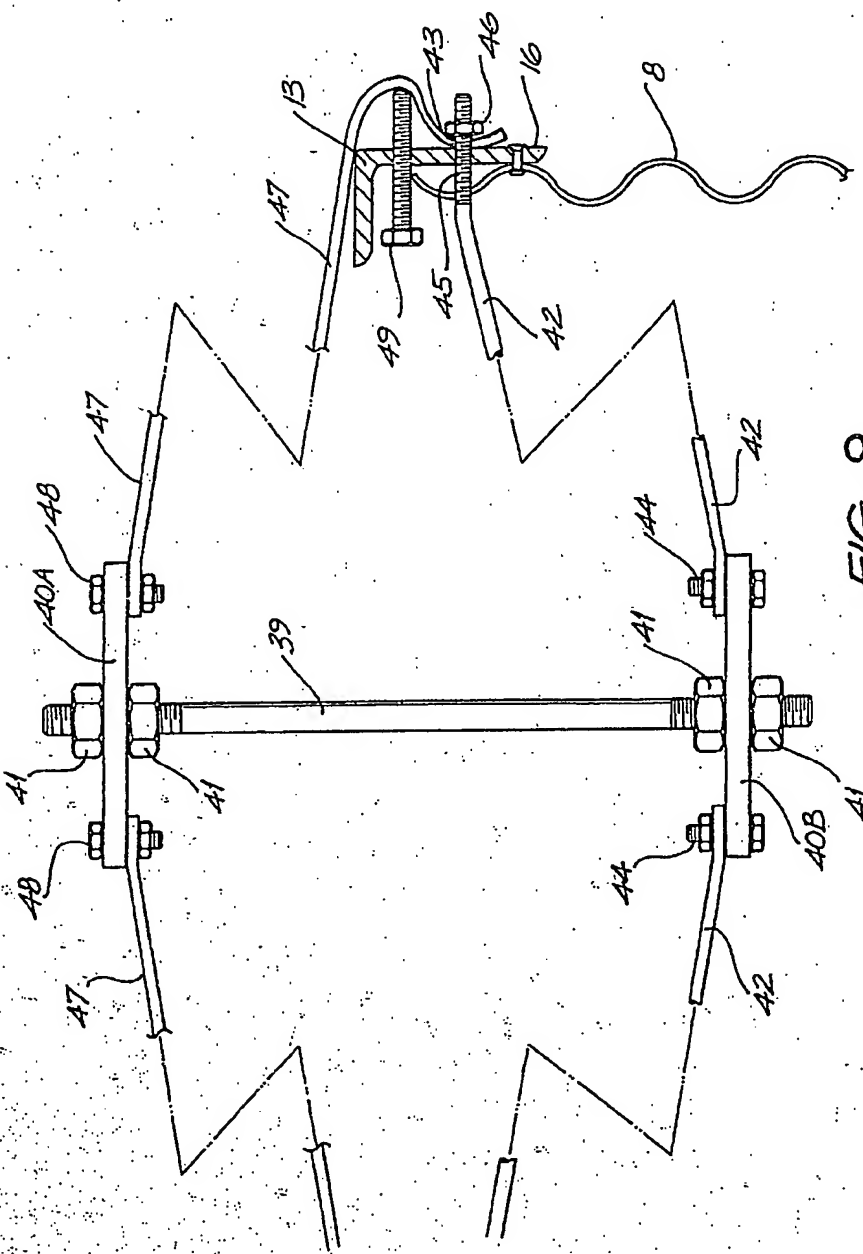


FIG. 9

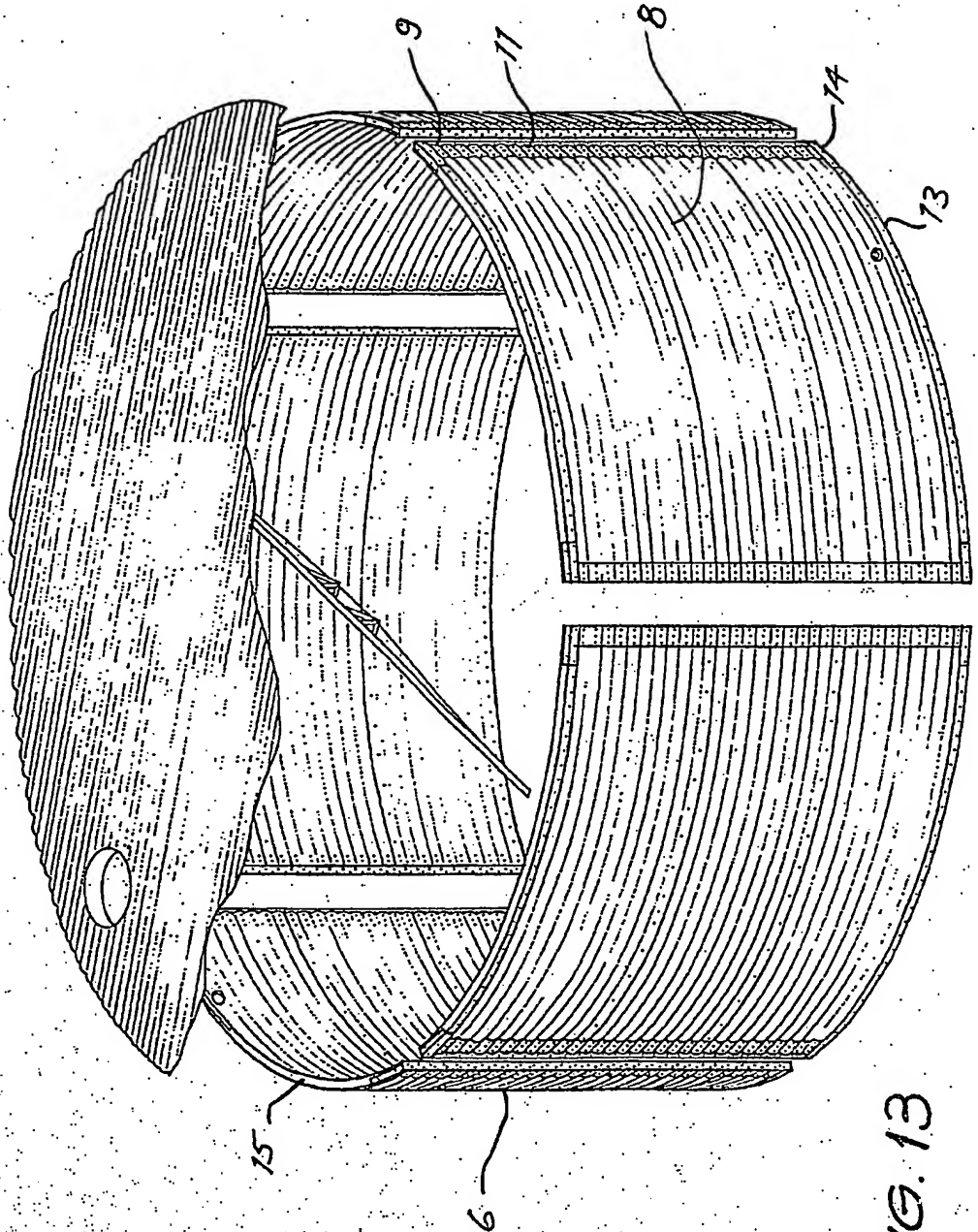


FIG. 13